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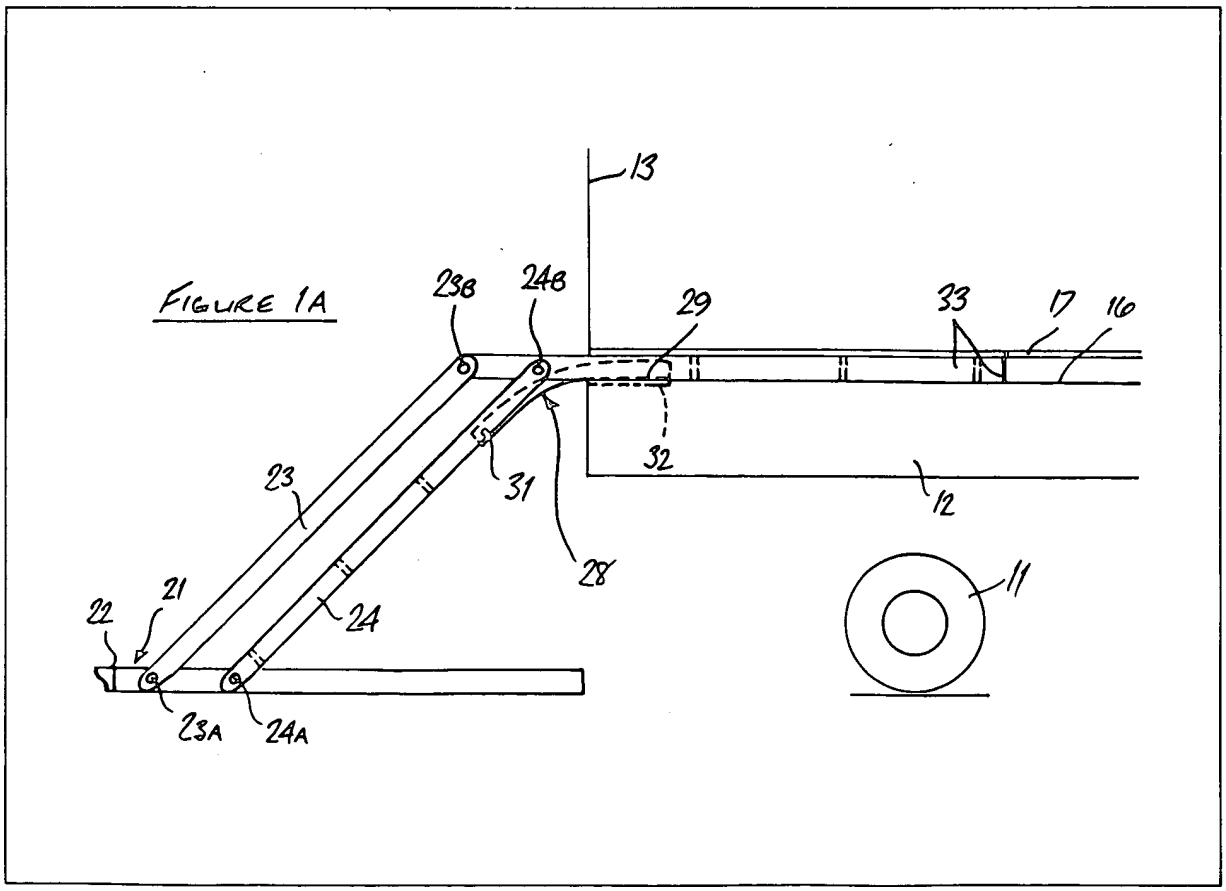
(54) **Platform lift**

(57) A load lifting and lowering platform 21 is pivotally suspended on the adjacent ends of the arms 23, 24, of a deformable parallellogram linkage. The other ends of the linkage arms are pivotted to a travelling chassis which, in use, moves back and forth out of and into a vehicle body serviced by the platform. One of the arms of the linkage engages a curved surface 28, and is forced to follow the curvature of that surface to automatically unfold or fold the linkage and thereby lower or raise the platform. The curved surface may be a rigid surface which can be swung up out of the way when the platform is stowed, or it may be a flexible bar as shown which can deform into a rigid curve to unfold the linkage and then progressively straighten again to fold the linkage.

Preferably the deformable bar travels with the chassis into and out of the vehicle body, and in one particular embodiment the platform, bar, linkage and travelling chassis all slide forward into a box which is fitted into the vehicle floor and is removable as a self-contained lifting unit.



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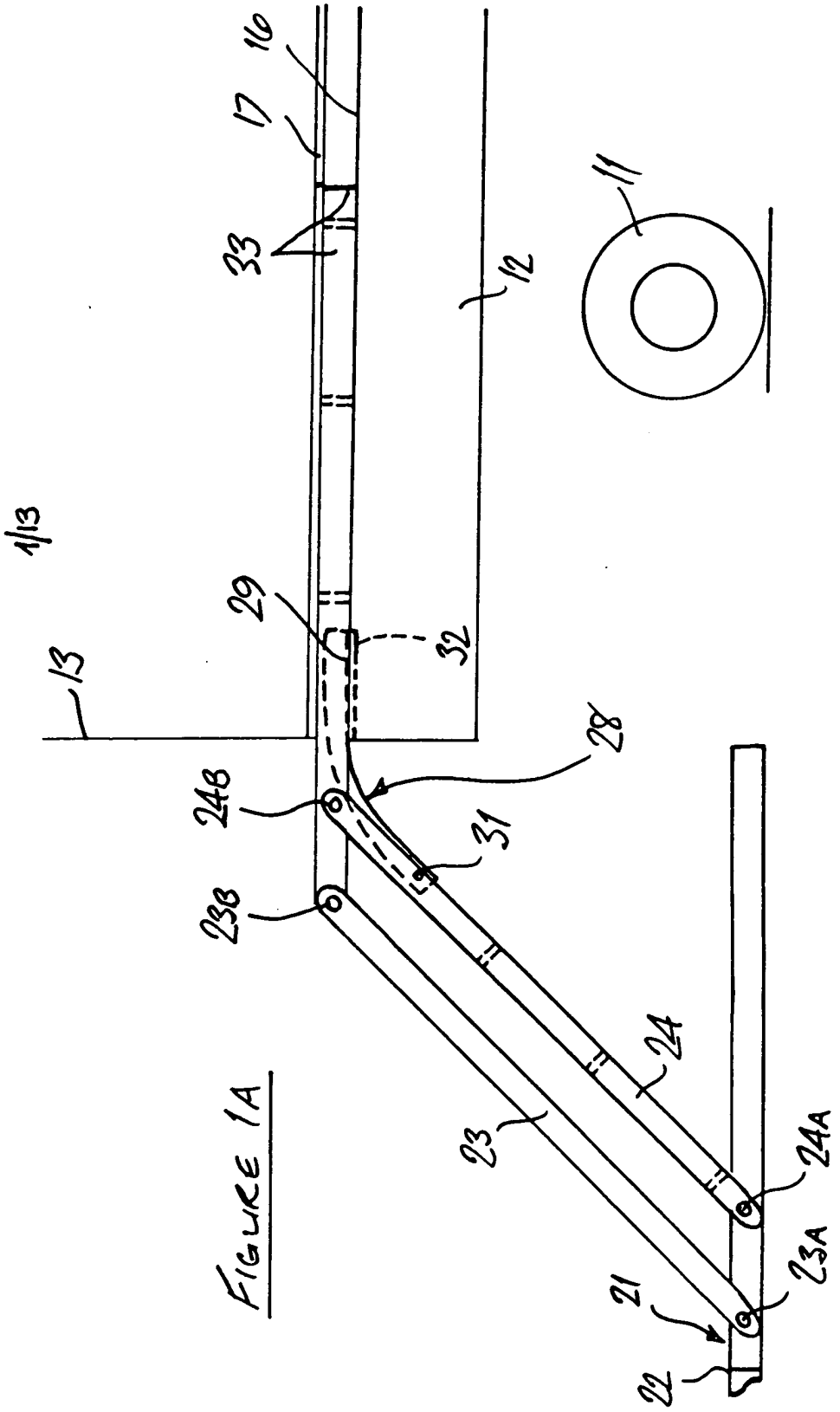


FIGURE 1A

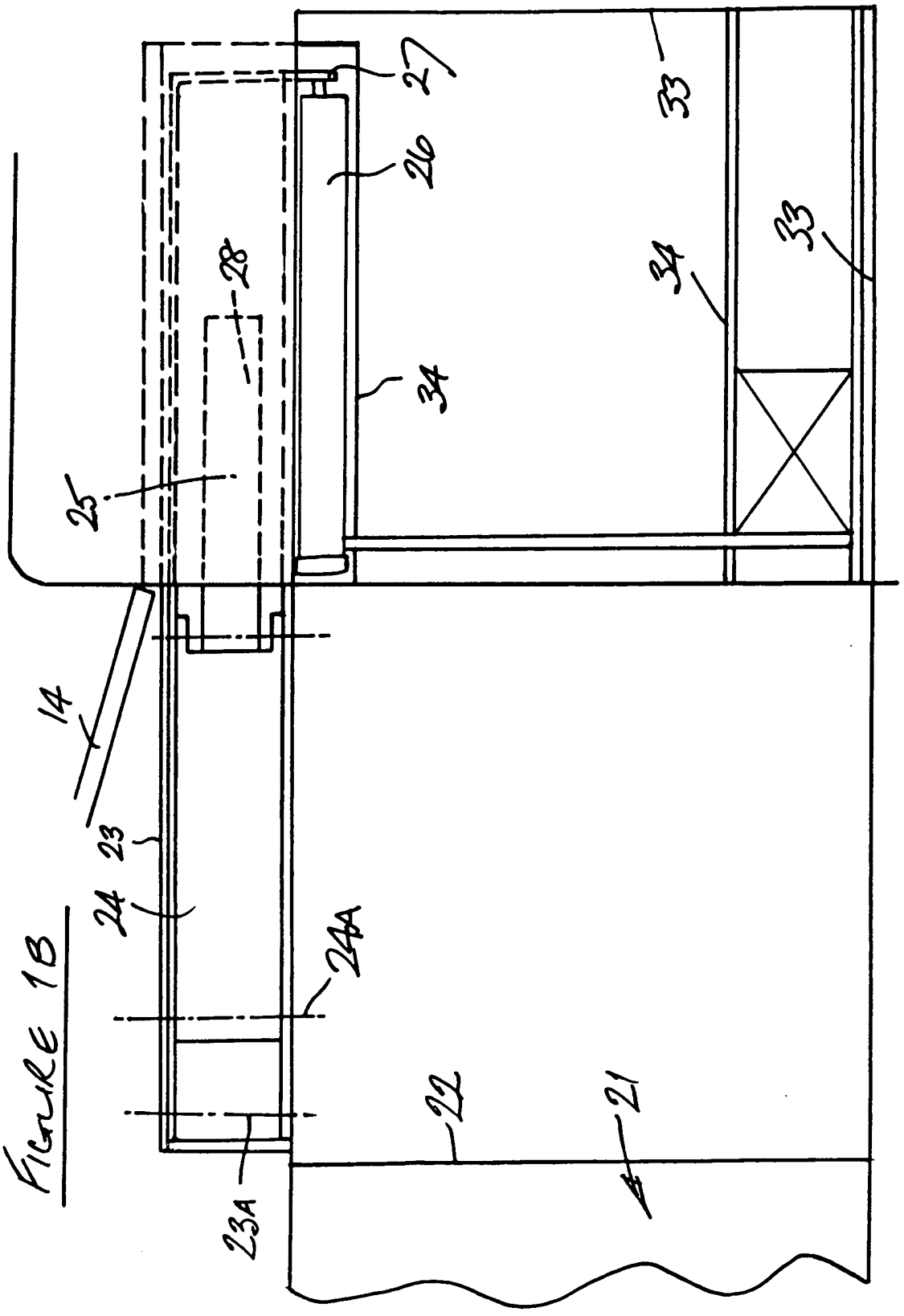


FIGURE 1B

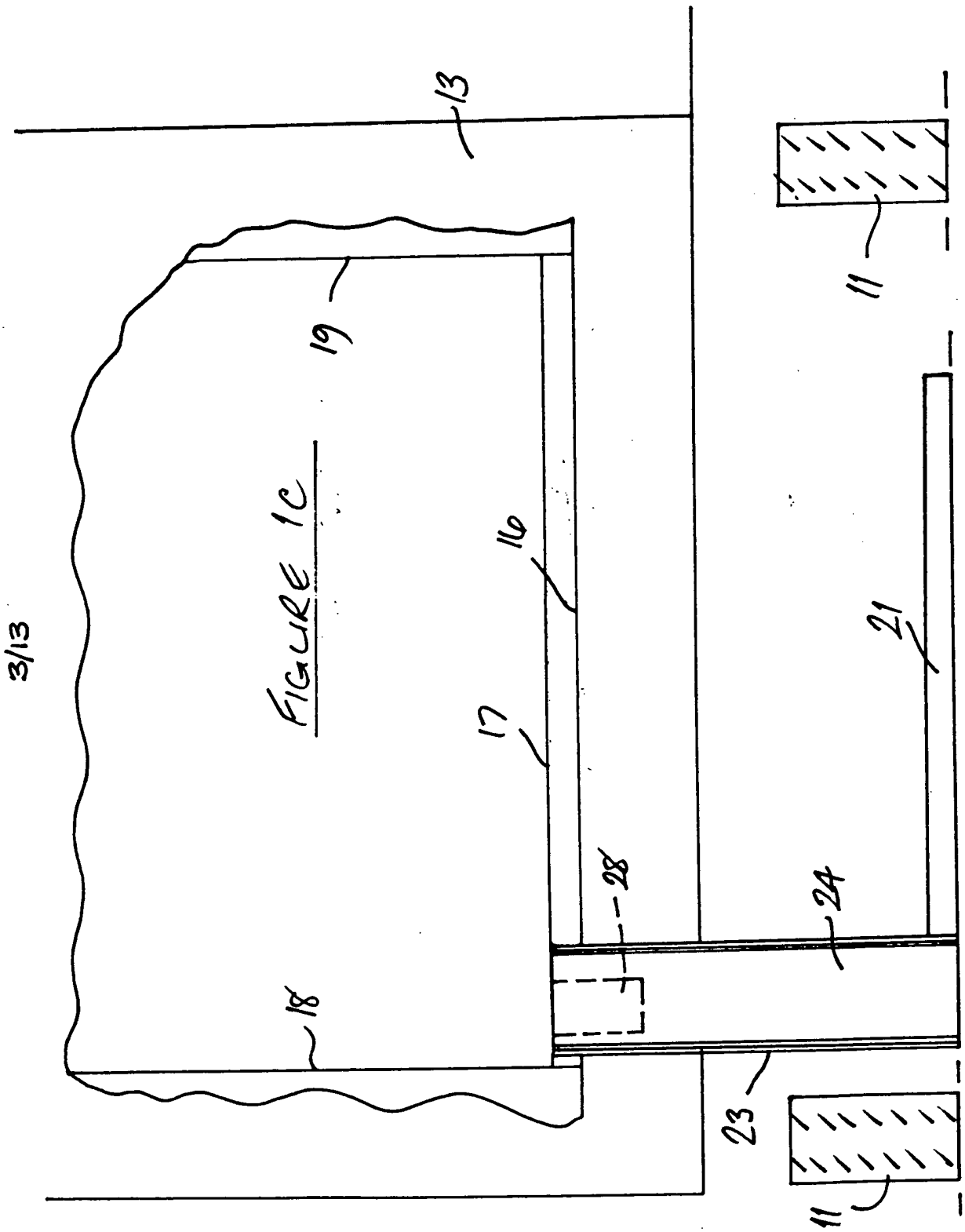
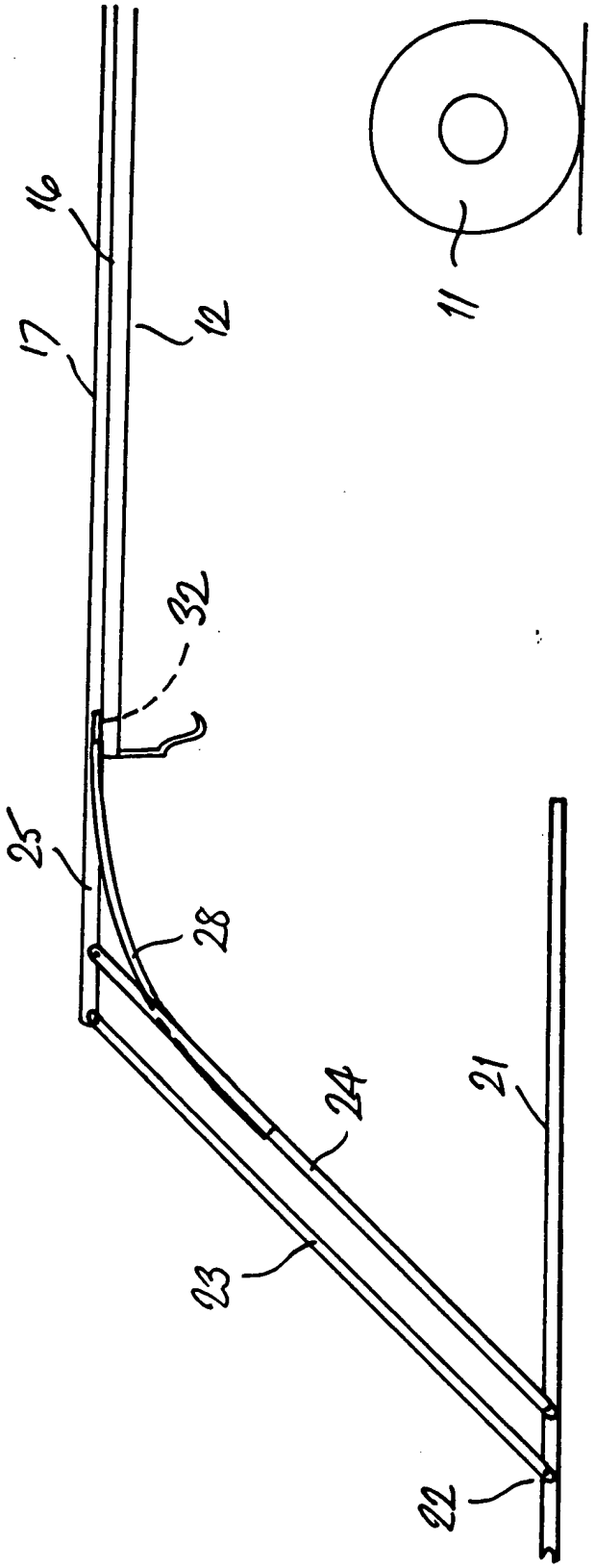


FIGURE 1C

FIGURE 2A



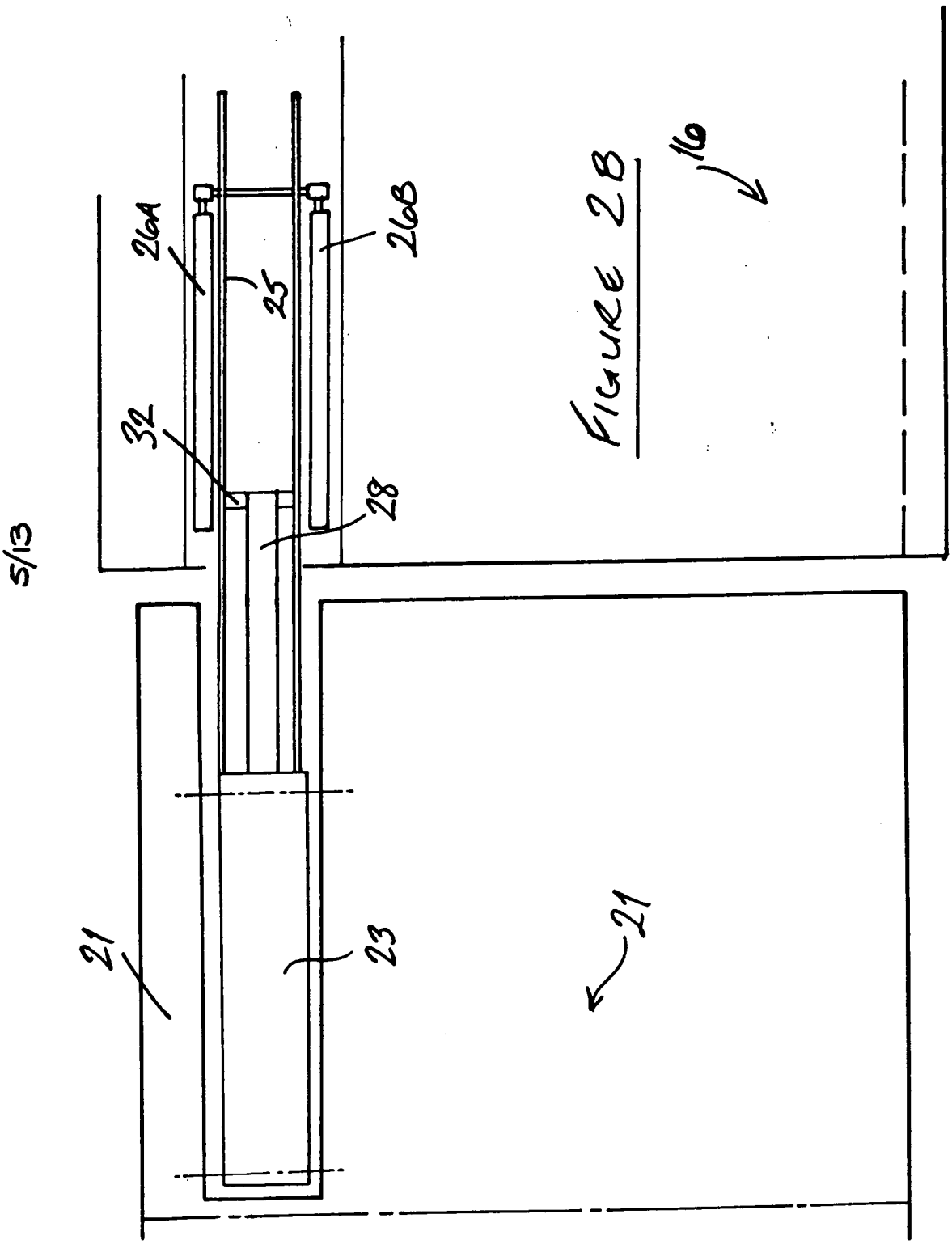


FIGURE 2B

FIGURE 3A

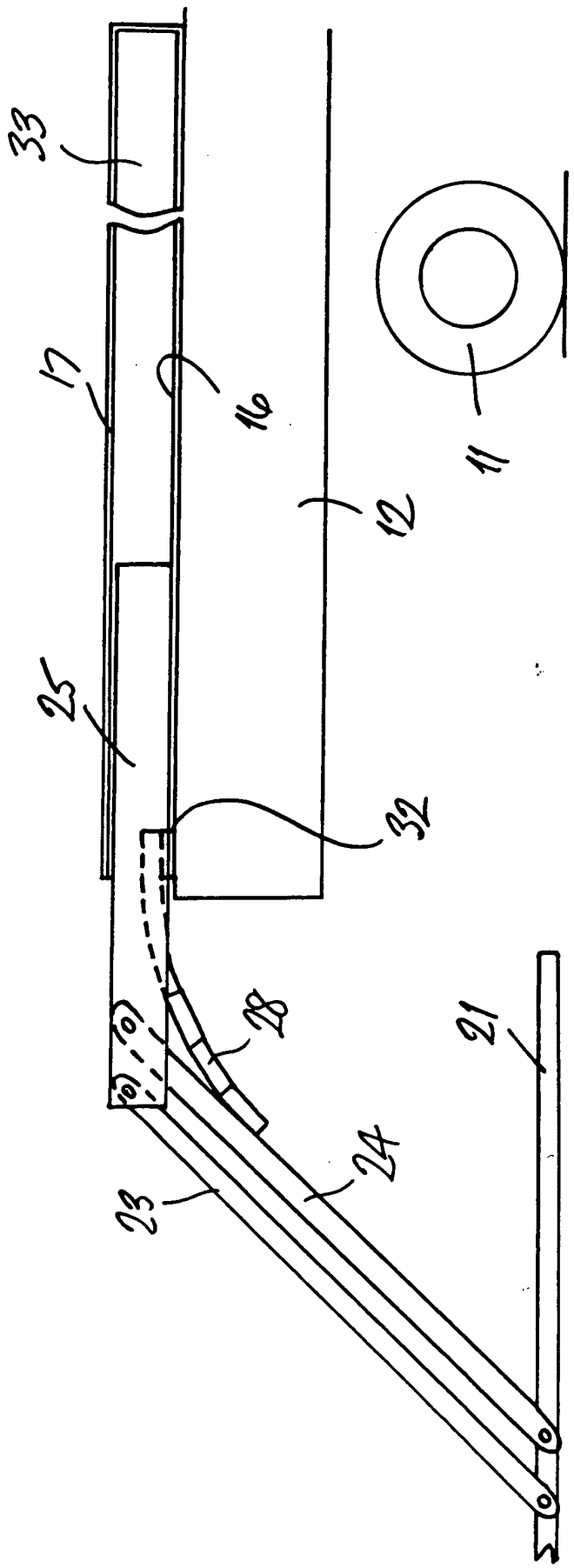
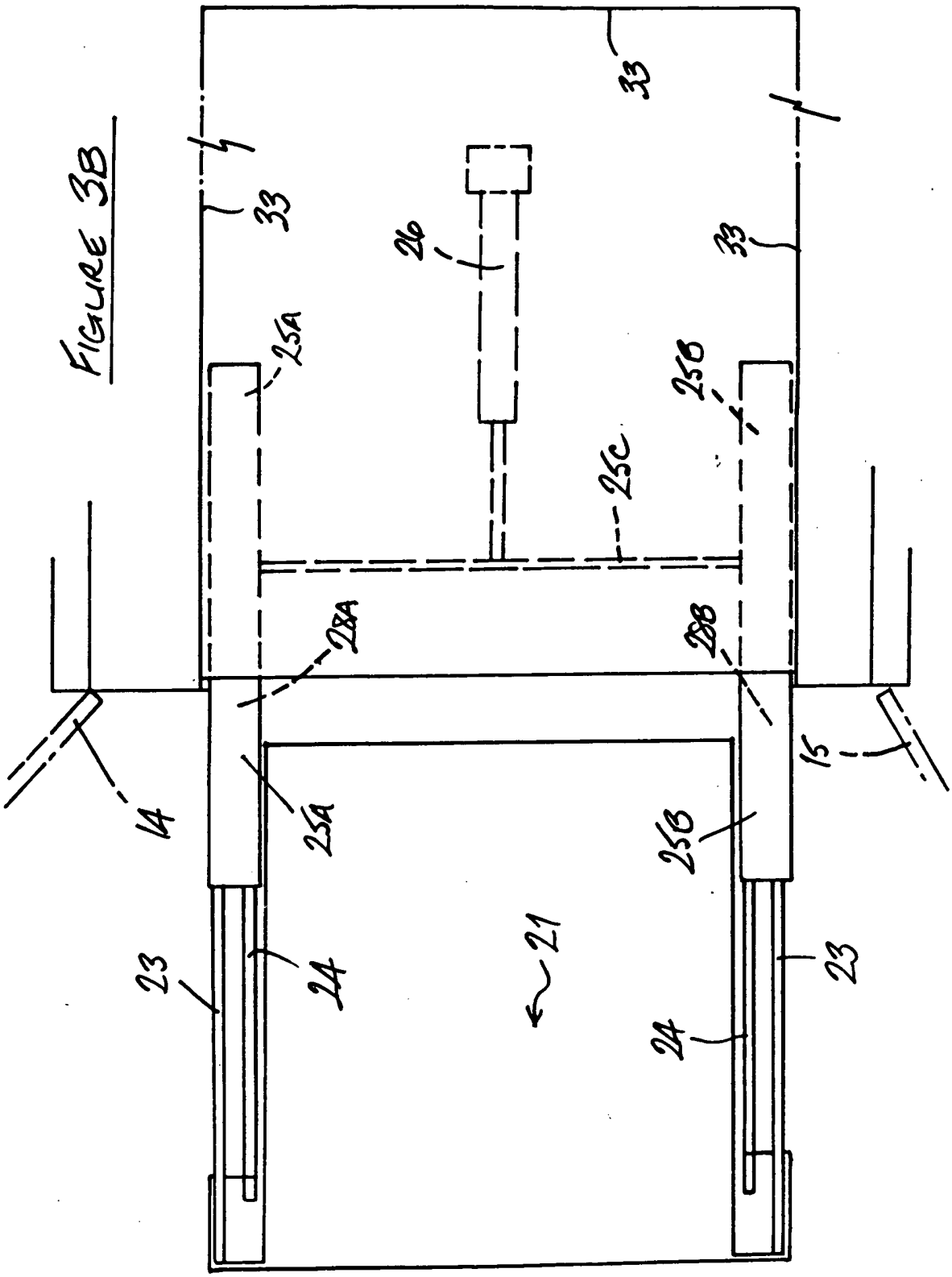


FIGURE 3B



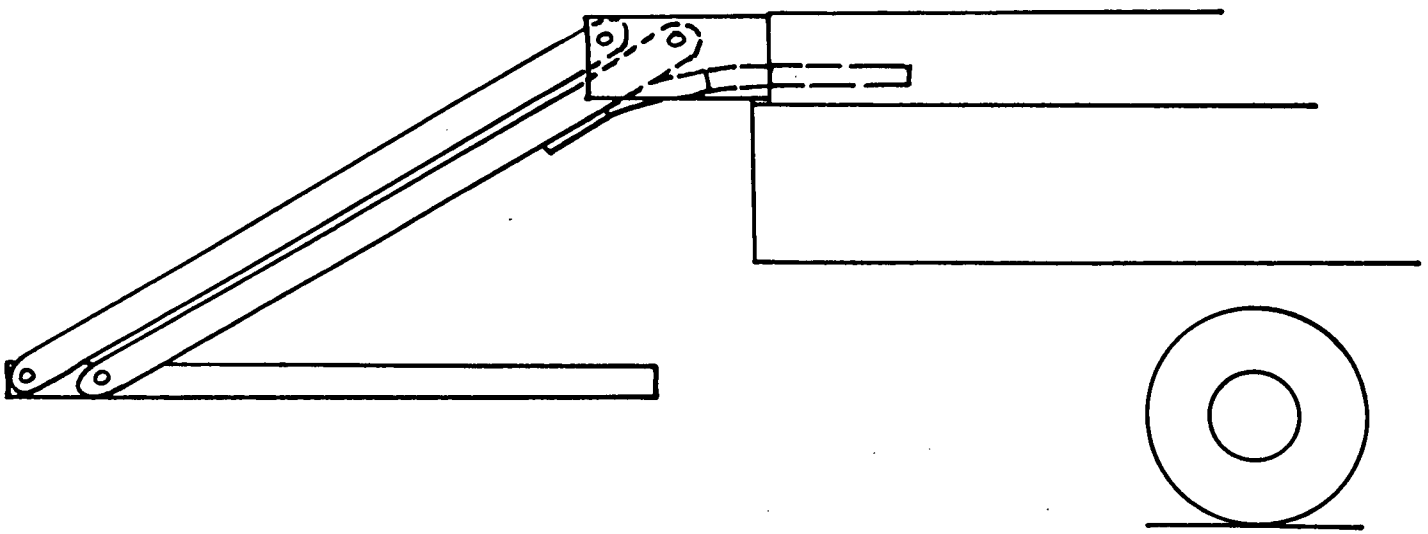


FIGURE 3C

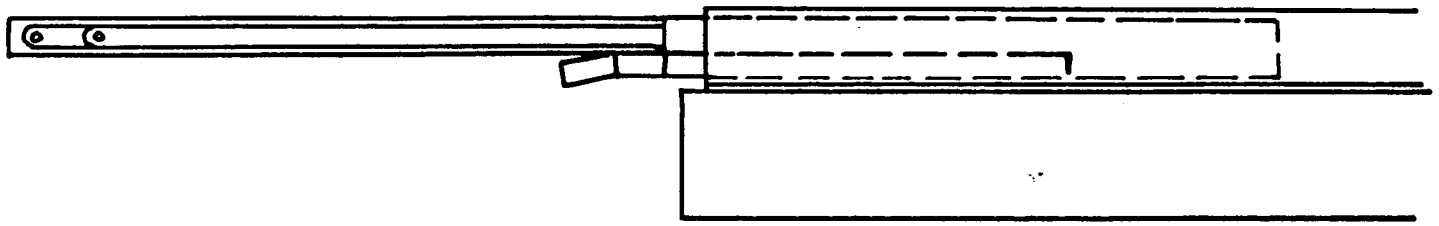


FIGURE 3D

FIGURE 4A

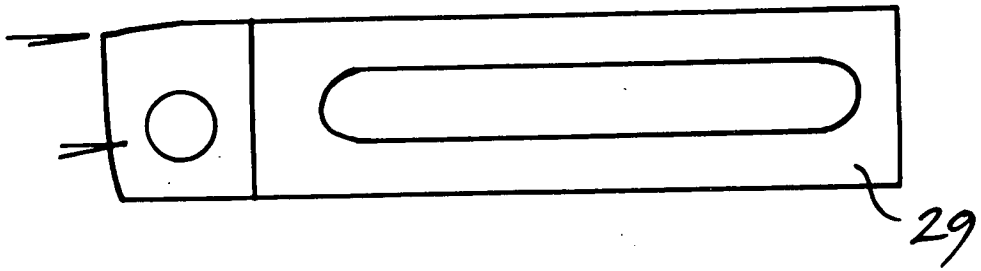
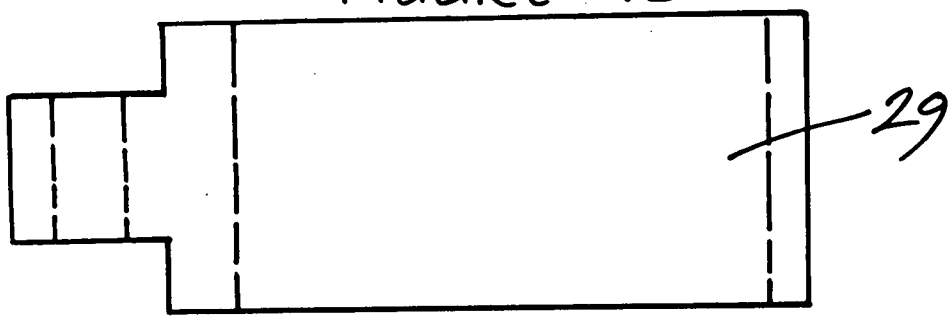


FIGURE 4B



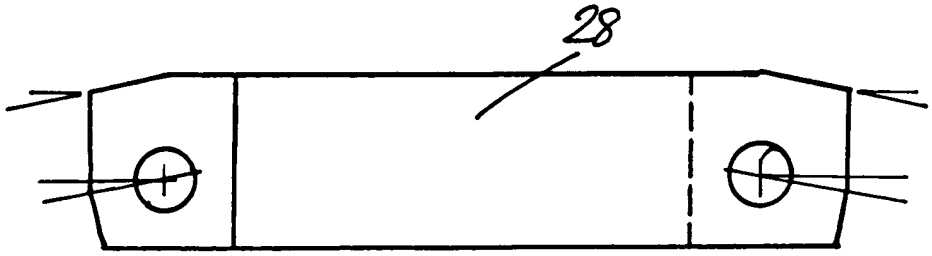


FIGURE 4C

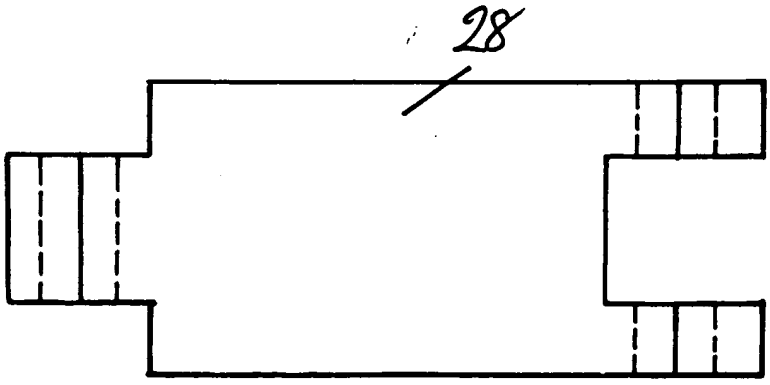


FIGURE 4D

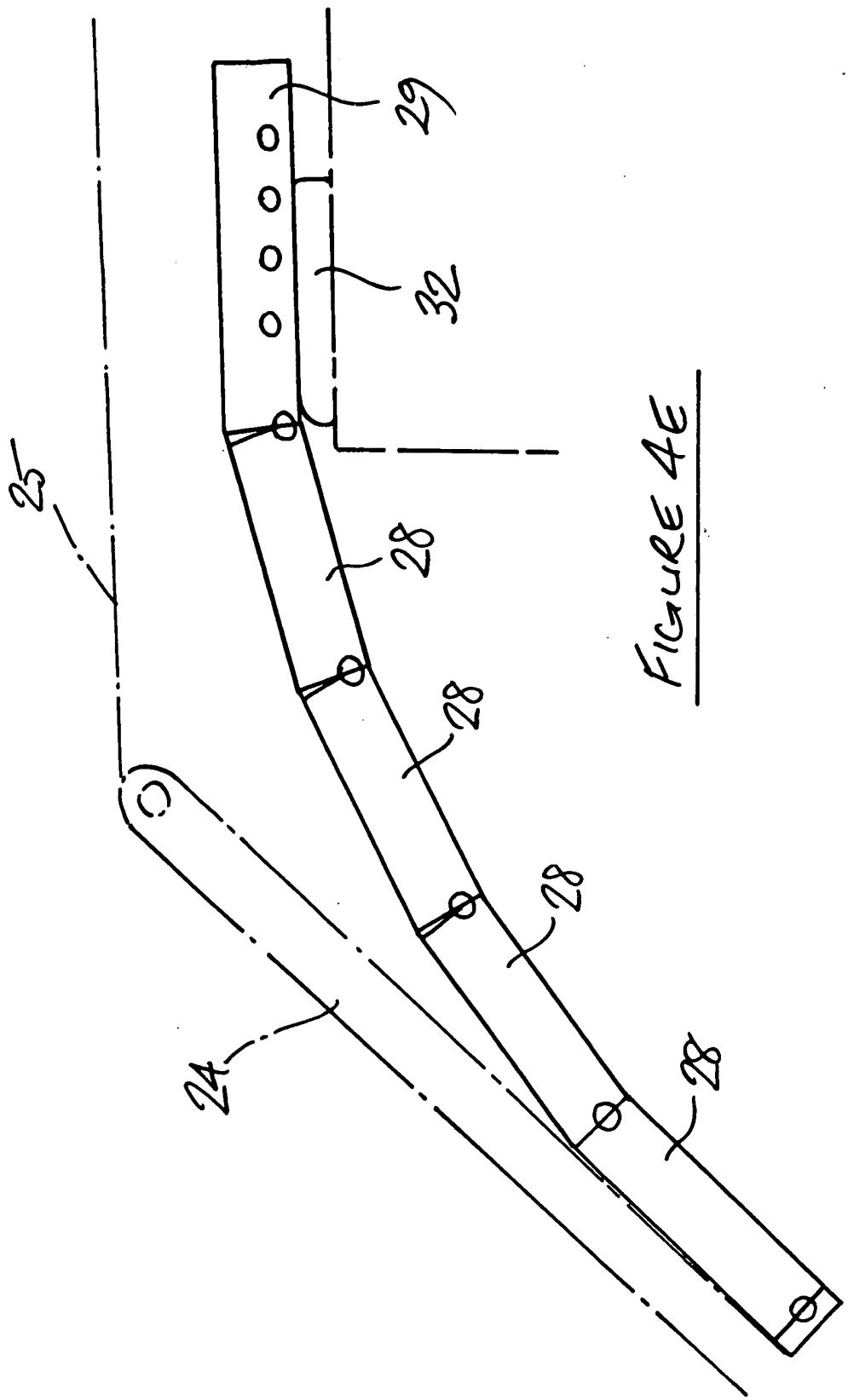
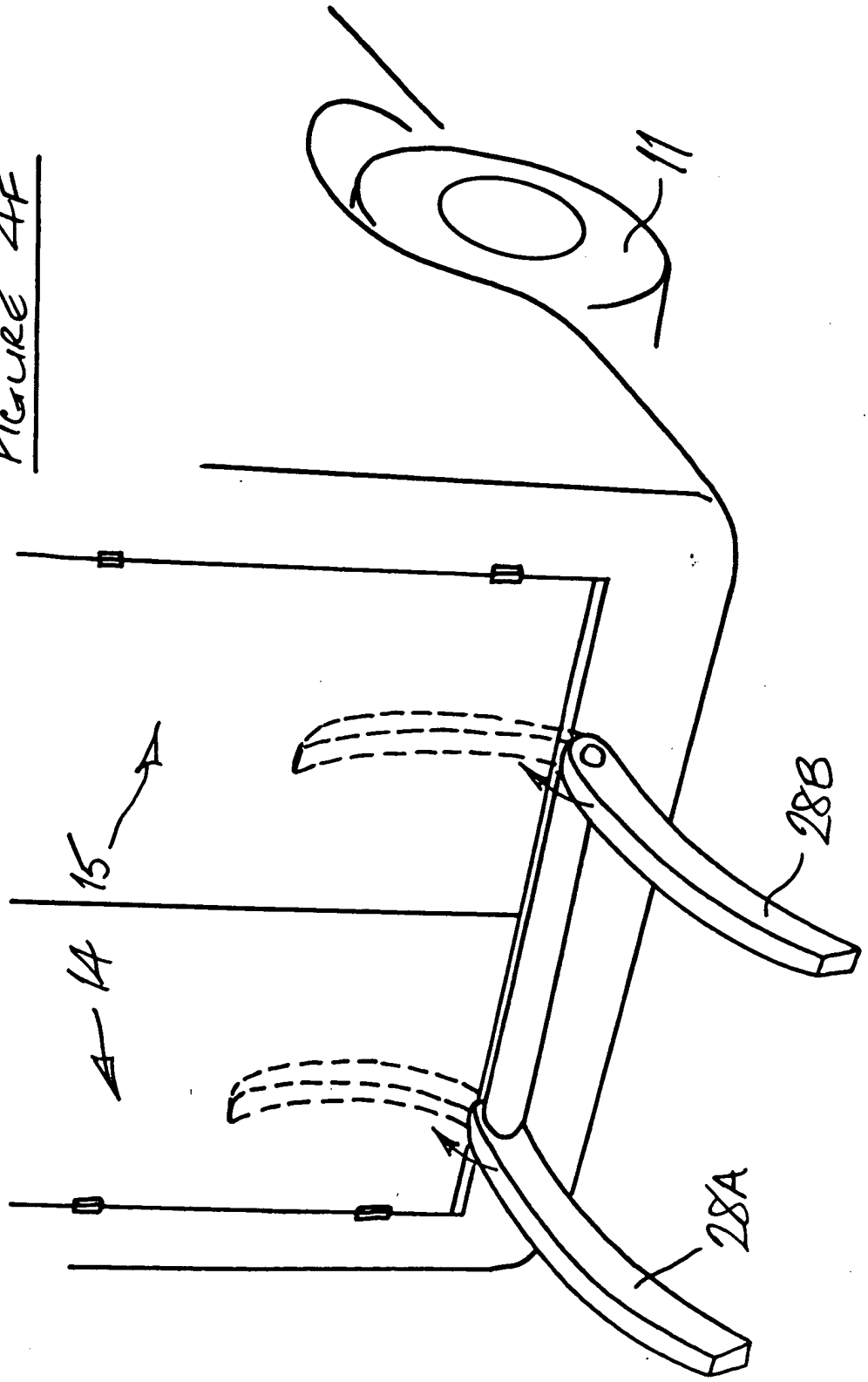


FIGURE 4E

FIGURE 4F



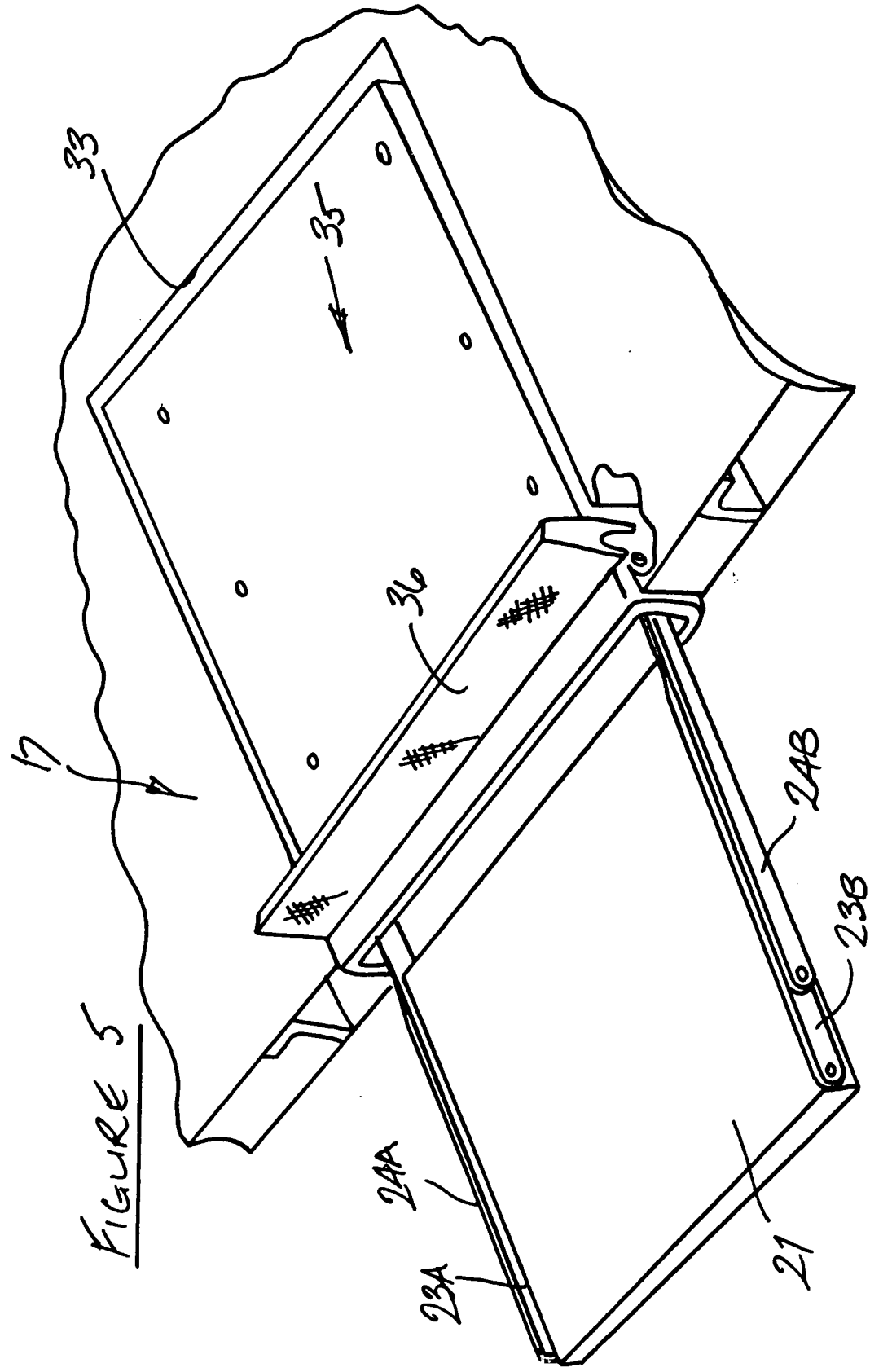


FIGURE 5

SPECIFICATION

V hicl lift

The present invention relates to vehicle lifts and in particular to cantilever type lifts suitable for attachment to the rear or side of a vehicle for use in loading and unloading of the vehicle.

Previously known cantilever lifts are generally swung upwardly against the rear of the vehicle across the opening thereat and project to a greater or lesser extent from the vehicle thereby preventing a close approach of the vehicle to a loading bay platform.

It is an object of the present invention to avoid or minimize one or more of the above disadvantages.

The present invention provides a vehicle lift comprising a generally parallelogram form linkage having a base member disposable at the underside of a vehicle, an articulated link member and a telescopic link member, and a movable member having a ramp means extending therefrom, said base, link and movable members being pivotally interconnected so that in use of the ramp said ramp is movable between a lowered position on the ground adjacent the vehicle and a raised position adjacent a load carrying platform of the vehicle whilst remaining generally parallel to said load platform, by a first pivotal displacement means, said movable member and ramp being pivotable relative to the articulated link member without substantial pivotal movement of the telescopic link member and with partial telescoping of the telescopic link member, so as to swing the movable member with the ramp in its folded condition up and over relative to the articulated link member, said articulated link member then being at least partly foldable upwardly by a further pivotal displacement means with further telescoping of said telescopic link member, said link members then being further pivotable upwardly relative to the base member towards the underside of the vehicle by said first pivotal displacement means.

If conveniently an auxiliary pivotal displacement means is provided for use in swinging upwardly the folded ramp prior to folding up of the articulated link member, though if desired the ramp may be swung up manually, advantageously with spring-assistance from a suitably mounted resilient biasing means.

With a vehicle of the invention the relatively extended parallelogram linkage required to provide the necessary ramp lifting action is substantially reduced in extent in the stowed position so that the linkage and the ramp are both stowable below the vehicle underside substantially out of the way thereby permitting the vehicle to approach a loading platform more or less as closely as a similar vehicle without a cantilever tail lift.

Various suitable pivotable displacement means may be used in accordance with the present invention. Conveniently pressurized fluid operated piston and cylinder means are used especially hydraulically operated, preferably electro-hydraulically operated, ones.

Further preferred features and advantages of the present invention will appear from th following. detailed description given by way of example of some preferred embodiments illustrated with reference to the accompanying drawings in which:

Figure 1 is a generally schematic perspective view of a tail lift of the invention mounted on the rear of a vehicle;

Figures 2 to *5* are schematic and partially omitted side views showing the principal stages of the stowing operation of the tail lift of Figure 1 with the successive positions of the principal parts thereof; and

Figures 6 to *8* are generally similar schematic and partially omitted side views showing the principal stages of the stowing operation of a further embodiment of the invention.

Figure 1 shows a tail lift 1 of the invention mounted at the rear 2 of a vehicle 3 (shown in chain line) adjacent and below a rear opening 4 and the rear end 5 of the load deck 6 of the vehicle 3. The tail lift 1 comprises a load platform 7 mounted 8 on a generally parallelogram form linkage 9 which is in turn mounted 10 at the underside 11 of the vehicle load deck 6.

In more detail the parallelogram linkage 9 comprises a base member 12 which is secured to the vehicle underside 11, a first, articulated 13, link member 14, a second, telescopic, link member 15, and a movable member 16 secured to the load platform 7. As may be seen in Figure 1, the parallelogram form linkage means comprises two substantially identical units disposed at opposite sides 17, 18 of the load platform and vehicle assembly.

A first pivotal displacement means 19 is mounted along the longitudinal centre line of the vehicle centrally between the sides 17 and 18. One end 20 of the displacement means 19 is secured to a main beam bracket 41*a* (See Figure 6) and the other is pivotaly connected 21 to a transverse beam 22 whose opposite ends 23, 24 are connected to respective ones of the articulated link members 14 at the inboard ends 25 thereof in proximity to the base member 12. An auxiliary pivotal displacement means 26 has one end 27 connected to a main beam lug 41*b* (see also Figure 6 below) and its other end 28 connected to the load platform 7 at a connection lug 29 spaced outwardly from the inboard edge 30 of said load platform 7.

A further pivotal displacement means 31 has one end 32 connected to a transverse beam lug 22*a* and its other end 33 connected to the outboard end portion 34 of the articulated link member 14. The load platform 7 has an outboard section 35 with a tapered free edge 36 for facilitating movement of wheeled goods containers (not shown) onto and off the load platform and is hingedly connected 37 to an inboard section 38.

In use of the tail lift 1, with the load platform 7 and the parallelogram linkage 9, fully deployed as shown in Figure 1, the load platform is maintained substantially parallel to the vehicle load deck 6 and is pivotally movable between a lowered position adjacent the ground 39 immediately behind the vehicle and a raised position immediately behind the

rear end 40 of the vehicle load deck 6 whilst being maintained in said substantially horizontal attitude, the movement being effected by the first pivotal displacement means 19 which is retracted in the lowered position and extended in the raised position of the load platform.

The sequence of operations involved in stowing of the tail lift will now be described with reference to Figures 2 to 5, in which various parts have been omitted and the second and third pivotal displacement means represented by their centre lines only, for the purposes of improved clarity. With the load platform 7 in its lowered position, the outboard section 35 is folded over onto the inboard section 38. The auxiliary pivotal displacement means 26 is then retracted swinging the load platform 7 over to an angle of approximately 120° towards the rear end 5 of the load deck 6 resulting in partial telescoping of the telescopic link member 15 and a pivotal displacement of the articulated link member 14 relative to the telescopic link member 15 so that they assume a partially crossed-over disposition as viewed from the side (see Figure 3). Retraction of the further pivotal displacement member 31 then causes the articulated link member to break around its articulated joint 13 with further telescoping of the telescopic link member 15 (see Figure 4). The first pivotal displacement means is then extended to swing the by now substantially folded up tail lift close up against the vehicle underside 11 as shown in Figure 5. As may be seen in this drawing the tail lift in its fully stowed position does not project beyond the rear end 5 of the load deck 6 as is the case in conventional cantilever type tail lifts, thereby permitting close approach of the vehicle to a loading bay platform when the tail lift is stowed.

It will be appreciated that various modifications may be made without departing from the scope of the present invention. Thus for example although the pivotal displacement means shown in the drawings are in the form of piston and cylinder means, other well known mechanical devices could be used in their place.

Figure 6 is a detail view further illustrating the connections between the first and second pivotal displacement means 19, 26 and the other parts of the tail lift.

Figure 6 shows a main mounting beam 41 which extends between the downwardly depending base members 12 at either side of the vehicle. A pair of generally annular flanges 42 on the main beam 41 have pivotally mounted thereon bell-crank swivel brackets 43 to which the transverse beam 22 is secured 44 on one of the arms 45 thereof. The piston rod 46 of the first pivotal displacement means 19 is pivotally connected 47 to the other arms 48 of the bell-crank swivel brackets 43. As already noted above, one end 32 of the further pivotal displacement means 31 is connected to the transverse beam lug 22a.

As may be seen from the drawings the embodiment of Figures 7 to 9 is generally similar to that of Figures 1 to 6 and like parts have been identified by like reference numerals. In this second embodiment of Figures 7 to 9 the auxiliary piston and cylinder means 26 has been omitted and the movement of the ramp 7 between its fully lowered position and its initially folded up position, respectively shown by the s lid line and chain-like outlines in Figure 7, is effected instead manually with spring assistance from a resilient biasing means in the form of an elonate helical spring 52 (see Figure 7) at each side of the ramp 7, having one end 53 secured to the movable member 16 and 1b other end 54 to the main beam annular flange 42.

Figures 7 to 9 also show in more detail a suitable form and mounting arrangement for the further piston and cylinder means 31 used to fold up the articulated link member 14. The drawings show the rear end 49 of the vehicle underside 11 slightly recessed so as better to accommodate the folded up ramp 7 in its fully stowed position directly thereunder (see Figure 9). Finally it may be noted from Figure 7 in particular that the distal end portions 50,51 of both the articulated and telescopic link members 14, 15 are generally hook shaped.

CLAIMS

1. A vehicle lift comprising a generally parallelogram form linkage having a base member disposable at the underside of a vehicle, an articulated link member and a telescopic link member, and a movable member having a ramp means extending therefrom, said base, link and movable members being pivotally interconnected so that in use of the ramp said ramp is movable between a lowered position on the ground adjacent the vehicle and a raised position adjacent a load carrying platform of the vehicle whilst remaining generally parallel to said load platform, by a first pivotal displacement means, said movable member and ramp being pivotable relative to the articulated link member without substantial pivotal movement of the telescopic link member and with partial telescoping of the telescoping link member so as to swing the movable member with the ramp in its folded condition up and over relative to the articulated link member, said articulated link member then being at least partly foldable upwardly by a further pivotal displacement means with further telescoping of said telescopic link member, said link members then being further pivotable upwardly relative to the base member towards the underside of the vehicle by said first pivotal displacement means.

2. A lift according to claim 1 wherein said first pivotal displacement means is formed and arranged for acting between the base member and a proximal part of the articulated link member pivotally connected to said base member.

3. A lift according to claim 1 or claim 2 wherein said further pivotal displacement means is formed and arranged for acting between said proximal part of the articulated link member and a distal part of the articulated link member pivotally connected to the movable member.

4. A lift according to any one of claims 1 to 3 wherein said articulated link member has an articulated joint formed and arranged so as to hav

chassis 25 which is itself basically in the form of a stiff rectanglular framework. The rod end of the ram 26 is connected, as shown at 27, to that end of the chassis 25 remote from the double doors 14, 15 of the van body. The ram cylinder is fixed within the vehicle body, but when the rod of the ram extends it carries the chassis 25 with it on rollers, needle bearings, or another anti-friction travelling slides which need not be illustrated and are not referenced.

A flexible elongate bar 28 is pivotally secured at one end 29 to the travelling chassis 25 and at its other end 31 to one of the linkage arms 24. The construction of this bar 28 will be described in detail later on in this specification, but basically, with the parallellogram linkage unfolded as shown in Figure 1a, the bar 28 is deformed into a rigid curve, whilst when the ram 26 is actuated to draw the chassis 25 to the right (viewed as in Figure 1a) the sections of the flexible bar 28 are drawn successively over a wear pad 32 and into the vehicle and the bar 28 is progressively straightened.

As the ram 26 is extended, and the bar 28 progressively straightens over the wear pad 32, the arm 24 is forced to follow the curvature of the bar 28 and will thus be pivotted clockwise (viewed as in Figure 1a) about its pivot 24b. This will automatically fold the parallellogram linkage and swing the platform 21 from its position shown in Figure 1a to a new position in which, when the bar 28 is fully straightened with pivot 31 on the point of entering the van body, the load-bearing surface of the platform 21 is at substantially the same level as the level of the false floor 17 inside the van body; and the platform 21, the linkage arms 23, 24, and the travelling chassis 25 all lie in substantially the same plane. At that stage, the rear half of the platform 21 can be swung about the hinge 22 completely over on to the front half of the platform, the load first having been transferred from the platform on to the false floor 17. The lift unit, consisting of the platform, the linkage arms, and the travelling chassis, can then be slid forward on suitable bearings (not shown or referenced) into a gap 33 cut into the false floor 17. Slides 34 are provided to ease the passage of the platform into the vehicle body. When fully home, the platform fits neatly into the gap 33, although the rear half of the platform will of course project above the general level of the false floor 17.

The hinge 22, which is the rearmost part of the lift unit when the unit is stowed into the vehicle in the manner just described, is sufficiently far inside the vehicle for the double doors 14, 15 to be closed on it. The doors thus hold the unit as a whole in place inside the vehicle during vehicle travel.

There is only one parallellogram linkage and travelling chassis, mounted at one side of the platform, as Figures 1a to 1c clearly show. At least the arm 24 is therefore substantially braced and stiffened to resist twisting of the platform as the platform is raised and lowered. The final stowing sliding movement of platform, linkage arms, and travelling chassis as a single unit into the gap 33 in the false floor 17 may be accomplished by continued extension of the ram 26; or it may be a hand movement since the unit simply needs to be slid fully home before the double doors 14, 15 can be closed on it.

Figures 2a and 2b show a variation on the construction of Figures 1a to 1c. A single deformable parallellogram linkage is again used, but there are two fluid pressure operated rams 26a, 26b moving the travelling chassis 25 back and forth into and out of the vehicle. Also in this case the vehicle is not an enclosed van but is an open-topped truck. The platform 21 can fold, but for extra long loads the twin cylinders 26a, 26b can continue to extend along the floor of the open truck and carry the whole length of the platform 21 on to the truck body without the platform having to be folded and without an extra long load having to be taken off it. In this version also, the platform 21 occupies substantially the full width of the access opening to the truck body. By contrast, the platform of Figures 1a, 1b and 1c does not span the full width of the access openings 17, 18, 19.

Apart from these alterations the arrangement of Figures 2 is essentially the same as that of Figures 1, and parts of the two sets of figures which correspond to one another have been given the same reference numerals.

The lift shown in Figures 3a to 3d has many similarities to those illustrated and just described with reference to Figures 1 and Figures 2. Corresponding parts have again been given the same reference numerals. However this lift has its platform 21 suspended between two parallellogram linkages, one on either side of the platform. There are accordingly two travelling frames 25a, 25b joined by a crossbar 25c to form the travelling chassis 25. As previously, the chassis 25 travels on suitable bearings into the vehicle body, but the arm 24 of the parallellogram linkage need not be so rigid because there are two linkages to take the strain of the platform and its load.

In the Figure 3 embodiment, the deformable flexible bar 28 is again used and is secured at one end to the frames 25a, 25b. There are two bars 28, one for each frame of the travelling chassis 25. However the other ends of the bars 28 are not secured to the arms 24 of the parallellogram linkage. The undersides of the arms 24 bear against their respective curved bars 28, and are forced to follow the curvature of the bars 28 progressively straighten when the frames 25a, 25b are pulled into the vehicle by a single centrally mounted cylinder 26. However the movement between the arms 24 and bars 28 is a frictional sliding one: as the bars 28 straighten, they force the arms 24, and hence the entire parallellogram linkages, to fold upwards.

Figures 3a, 3c and 3d show the gradual progressive upward folding movement of the parallellogram linkages. As before, once the Figure 3d position is reached, the cylinder 26 can continue to extend to pull the platform lift unit fully into the vehicle; or the unit can be pushed home by hand since it needs only to slide horizontally along suitable bearings. It will be noted that the platform 21 extends, in this embodiment, no farther than the ends 23a, 24a of the linkage arms 23, 24. The whole lift unit can be pushed home from its Figure 3d position with ut the

load having first to be removed from the platform 21. The platform can subsequently be pulled out of the vehicle, and lowered back to its Figure 3a position, with the load still on it.

Figures 4a and 4b show the precise form of the inner endmost link 29 of the flexible bar 28. Figures 4c and 4d show similarly the form of the remaining links which go to form the flexible bar 28. There are five of these links in the or each bar 28, plus the top link 29, and they are all pin-jointed by suitably hardened steel pins which are not shown in detail. Figure 4e shows the bar 28 deformed into a rigid curve free-hanging from the back of the vehicle to which the lift is fitted (i.e. in position corresponding to Figures 1a, 2a and 3a). When the bar is pulled to the right of Figure 4e over the wear-pas 32, it will inevitably straighten and in doing so it will fold the parallellogram linkage or linkages upward and raise the platform from the ground to the level of the vehicle floor. Figure 4f shows solid bars 28 in use.

Finally Figure 5 shows in diagrammatic perspective another form of lift embodying the invention, this time entirely hand-operated. The platform 21 is suspended as in Figures 3 between two parallellogram linkages 23, 24, one on either side of the platform, and there are again two travelling frames 25a, 25b linked by a cross-beam 25c to form the travelling chassis 25.

Figure 5 shows the lift unit in position corresponding to that of Figure 3d, i.e. with the platform, linkage arms, and travelling chassis all occupying substantially the same plane and ready to be slid into the vehicle which carries the lift. When slid forward into the vehicle, the lift unit enters an open-ended box 35 in which it is eventually fully accommodated. The double doors, not shown in Figure 5, can then be closed on the unit. The box 35 fits into a gap 33 in the false floor 17 of the van and is securely screwed or bolted in place. The entire lift unit can thus be removed, by simply unscrewing the box 35 and taking the unit out of the vehicle. Spring assistance is provided to raise the platform 21 of Figure 5 into the position shown in Figure 5. The springs may take the form of torsion springs in the pivots of the parallellogram linkage. Alternatively the flexible bars 28 may be spring-loaded 'straight' and, if their outer ends 31 are positively secured to the arms 24 of the parallellogram linkages, will then resist unfolding of the linkages. Once the linkages are unfolded, for example by two men sitting on the platform to sink it to the ground, and the platform has been loaded, the spring action will assist in bringing it back to its Figure 5 position.

Sliding the platform and the rest of the lift unit home into the vehicle from the Figure 5 position need not be spring assisted, since only horizontal pushing movement is needed.

A locking plate 36 is shown in Figure 5. When the platform 21 of Figure 5 is on the ground, with its parallellogram linkages unfolded, the plate 36 can be swung down and the front edge of the plate engages a notch (not shown) in each of the upper surfaces of the front arms 23 of the parallellogram linkages to hold the linkages open against the spring action. When the platform is ready to be lifted, the plate 36 is released from the notches but it is not yet returned to its Figure 5 position. Instead it rides along the tops of the arms 23 as the platform 21 comes up. When the platform 21 reaches its Figure 5 position, the plate 36 rests substantially horizontally across the tops of the arms 23 and closes the gap between the platform and the box 35 to allow loads to be transferred from the platform into the vehicle. Finally the plate 36 is swung to its Figure 5 position to allow the platform, the parallellogram linkages, and the travelling chassis to be slid fully home into the box 35.

Once this has been done, the plate 36 can be swung anticlockwise (viewed as in Figure 5) through 180°C from its Figure 5 position to seal off the open end of the box 35 and keep the lift unit stowed inside it. Double doors, not shown, can close on the plate 36 when it is in this position.

In any of the arrangements illustrated, the flexible bar 28 could be spring-loaded 'straight' to assist the upward folding of the parallellogram linkages in the manner just described with reference to Figure 5, for example by torsion springs in its pivots. In the power operated hand stowed lifts described and illustrated, if the ram 26 fails, the lift can still be manually slid home and the vehicle driven back for repair to the power pack. This may be achieved simply by uncoupling the rod of the ram 26 from the travelling chassis 25. It is made easier if spring assistance is provided to fold the linkages as has just been described.

Instead of the platform rear part of Figures 1a to 1c folding completely over on top of the platform front part, it could fold through only 90 degrees from its illustrated position to stow vertically during vehicle travel.

Other forms of spring loading may be used in the wholly or partly hand-operated versions of the lift. For example, coiled tension springs could extend along the chassis longitudinally in place of the illustrated hydraulic rams, the springs opening against their tensioned action as the lift slides into its operating position and opening still farther as the linkage unfolds to lower the platform to the ground.

CLAIMS (Filed 8 June 1982)

1. A platform lift in which a load lifting and lowering platform is pivotally suspended on the adjacent ends of the arms of a deformable parallellogram linkage; the other ends of the linkage arms are pivotted to a chassis which is or can be mounted to travel back and forth out of and into a load-carrying area, for example a vehicle body, serviced by the platform; such back and forth travelling movement of the chassis causes one of the arms of the linkage (or a part connected thereto) to engage a curved surface; and the arm (or said part) is forced to allow the curvature of that surface, thus automatically unfolding or folding the linkage and thereby lowering or raising the platform.

2. A platform lift according to Claim 1 and in which, with the parallellogram linkage folded, the platform and the travelling chassis and the linkage arms all occupy substantially the same plane (or at

l ast lie closely adjacent one another) and th platform can be moved into the load-carrying area with the chassis and linkage.

3. A platform lift according to Claim 1 or Claim 2 in which the load-carrying part of the platform remains substantially level as it travels back and forth out of and into the load-carrying area.

4. A platform lift according to any of the preceding Claims and in which the curved surface is a rigid surface which is fixed to or which forms an extension of the load-carrying area and which is retractable when the platform is not in use.

5. A platform lift according to any of Claims 1 to 3 and in which the curved surface comprises a flexible bar which can deform into a rigid curve and which, in use, travels back and forth with the travelling chassis, the bar deforming into a rigid curve in order to unfold the parallellogram linkage as the chassis moves one way, and positively straightening again to fold the linkage as the chassis moves the other way.

6. A platform lift according to Claim 5 and in which the end of the flexible bar not secured to the travelling chassis is pivotally secured to said one of the linkage arms.

7. A platform lift according to any of the preceding Claims and in which the platform, the travelling chassis, and the parallellogram linkage all fold into substantially the same plane and can slide forward into a gap in the floor of the load-carrying area.

8. A platform lift according to any of the preceding Claims and in which the platform, the chassis and linkage when folded slide forward into a box which is fitted in the load-carrying area and which forms with the platform, linkage and chassis a self-contained removable unit.

9. A platform lift substantially as described herein with reference to and as illustrated in Figures 1A, 1B and 1C and Figures 4A to 4E of the accompanying drawings.

10. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figures 2A and 2B of the accompanying drawings.

11. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figures 3A to 3D of the accompanying drawings.

12. A platform lift according to Claim 9 when modified substantially as described herein with reference to and as illustrated in Figure 4F of the accompanying drawings.

13. A platform lift according to Claim 9 wh n m dified substantially as described herein with refer nce t and as illustrated in Figur 5 of th accompanying drawings.

14. A vehicle fitted with a platform lift in accordance with any of the preceding Claims.

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